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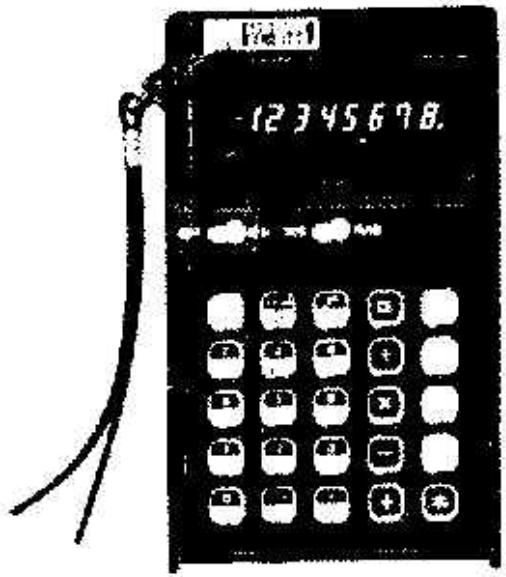
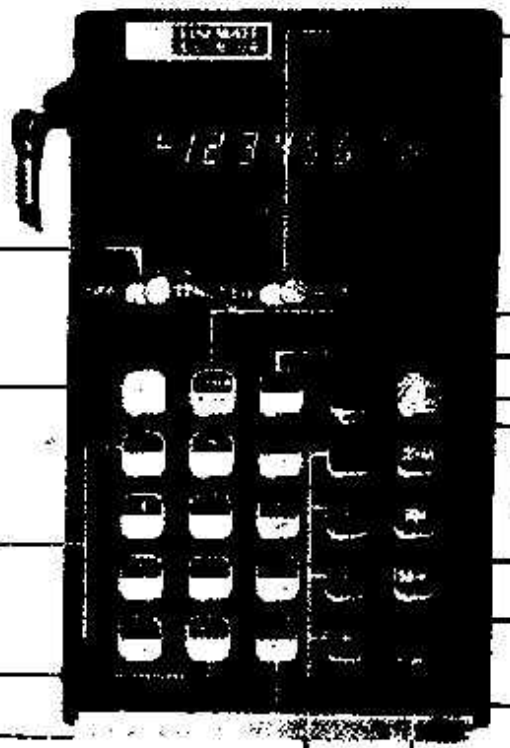
1. INTRODUCTION



Sharp's new pocket-computer EL-8109 can calculate up to 8 digits, including trigonometric, inverse trigonometric, logarithmic, exponential calculations and more!

Yet is so small you can slip it easily into your pocket and take it anywhere.

2. EXTERNAL FEATURES



3. FEATURES

- 4 arithmetic calculations, memory calculation, constant addition (subtraction, multiplication and division), chain multiplication and division, etc.
- Square root extraction:
  After setting numbers, operate (push) the [F] [√] keys.
- Trigonometric functions ($\sin x$, $\cos x$, $\tan x$):
  After setting numbers, operate the [F] ([sin] , [cos] , [tan]) keys.
- Inverse trigonometric functions ($\sin^{-1}x$, $\cos^{-1}x$, $\tan^{-1}x$):
  After setting numbers, operate the [F] ([sin⁻¹] , [cos⁻¹] , [tan⁻¹]) keys.
- Exponential function (e^x):
  After setting numbers, operate the [F] [ln] keys.
- Logarithmic functions ($\ln x$, $\log x$):
  After setting numbers, operate the [F] ([log] , [ln]) keys.
- Reciprocal calculation ($\frac{1}{x}$)
  After setting numbers, operate the [F] [1/x] keys.
- X^2 calculation
  After setting numbers, operate the [F] [x²] keys.
- Y to the X power calculation (Y^x)
- Minute/Degree, minute, second ↔ decimal notation degree transformation key ([°'"]).

4. EXPLANATION OF SELECTORS, KEYS AND INDICATORS

DEG-RAD mode selector

RAD: In case of trigonometric or inverse trigonometric calculation, the number which is operated (calculated) or the unit of answer can be obtained by setting in **"RAD"** position.

DEG: In case of trigonometric or inverse trigonometric calculation, the number which is operated or the unit of answer can be obtained by setting in **"DEG"** position.

When working with degrees or radians, the decimal portion of the number is read as a decimal, not as a form of minutes and seconds.

C : Clears all the calculation registers, error etc.
It will not clear the memory register.

CE : Clears display register.

0 ~ 9 : Number keys to enter a number, when these keys are pressed following F key, the function shown on the lower part of each key top will be computed.

· : Decimal point/π key

Upper: Designates the decimal point of a set number.

Lower: For entering π (F π)

[+/√] : Sign change/square root key

Upper: Inverses the sign of a displayed number.

Lower: Operation of the [F] and [√] keys orders the square root calculation.

[°'"] : Degree, minute, second ↔ decimal notation transformation key.

Upper: When the [°'"] key depressed, the degree, minute and second in the sexagesimal notation is transformed into the decimal notation degree.

Lower: When the [F] [°'"] key pressed, the decimal notation degree is transformed into the degree, minute and second in the sexagesimal.

[y^x x^2] : Y to the X power calculation/square key.

Upper: Operating the A [y^x] B [=] orders the A^B calculation.

Lower: Operating the [F] and [x^2] keys orders the square calculation.

[M+] : Memory-in key

Used to make the memory store displayed number. With this key depression, the content previously stored in the memory is cleared. To clear the content of the memory, take the operation of [C] [M+] .

[+] [−] [×] [÷] : Sets the order of each function.

[=] : Completes the addition, subtraction, multiplication, division or Y^x function.

[RM] : Displays the contents of memory register.
Content of the memory remains unchanged.
However, the content of the display prior to using the [RM] key is cleared.

[M+] : Adds displayed number to the memory.
The displayed number remains unchanged.

[F] : This key designates the function shown on the lower part of each numeral key top and [÷] , [√] , [×] , [%] .

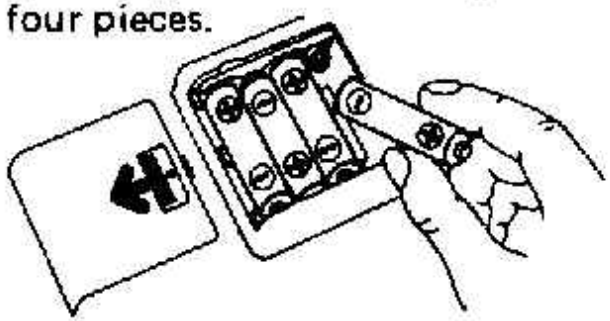
5. HOW TO INSERT AND REPLACE BATTERIES

Fading of the numerals in the display indicates that the batteries should be replaced. When replacing the batteries, always replace all batteries at the same time.
Replace the batteries as follows:

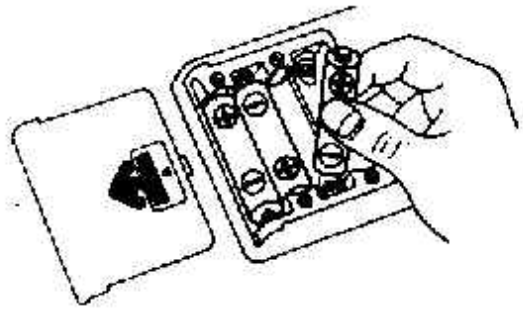
1. Turn off the power switch. Remove the battery cover by sliding it in the direction of the arrow (see fig. 1).
2. Remove the old batteries.
3. Insert three (3) manganese dry batteries or four (4) Ni-cd batteries. Be sure to match the positive (+) and negative (−) ends of the batteries with the markings in the battery holder (see fig. 2).
4. Replace the battery cover.
5. The Ni-cd batteries can be recharged by the aid of EA-14A.
   Charging time: 15 hours, (power switch at "OFF")*(at the rated voltage)
   Useful life: 6.5 hours
   (*If the power switch is set at "ON" no batteries can be recharged.)

Caution:

1. Dry batteries and Ni-Cd batteries should not be used as mixed.
2. When operating the set with dry batteries be sure to insert three pieces of type AA. Do not insert four pieces.



(How to replace the Ni-Cd battery (x4)



How to replace the dry battery (x3)

6. OVERFLOW ERROR

An overflow error will occur in the following cases.
When an overflow error is detected, a zero and *E* (or *E*) turn on and electronically interlocks all keys except the [C] key. Overflow error is cleared by pressing the [C] key.

1. When the integer portion of listed number exceeds 8 digits.
2. When the integer portion of sum, difference, product or quotient exceeds 8 digits.
3. When a number is divided by zero.
4. When error occurs in function calculations.

$\sin x$	**DEG** •	When $\lvert x \rvert \geqq 99999900$
$\cos x$	**DEG** •	When $\lvert x \rvert \geqq 99999900$
$\tan x$	**DEG** •	When $\lvert x \rvert \geqq 99999900$
		When $\lvert x \rvert = 90,270,450$ ..... (When the value is ∞)
$\tan x$	• **RAD**	When $\lvert x \rvert = \pi/2, 3\pi/2, 5\pi/2$ ..... (When the value is ∞)
$\sin^{-1} x$		When $\lvert x \rvert > 1$
$\cos^{-1} x$		When $\lvert x \rvert > 1$
e^x		When $x \geqq 18.420682$
		When $x \leqq -18.420683$

ln x	.....	When x ≤ 0
log x	.....	When x ≤ 0
1/x	.....	When x = 0
$\sqrt{x}$	.....	When x < 0
Y^x	.....	When Y ≤ 0
∘ , ,, →	.....	When the ⊡ kye is successively pressed five times.

Note: An overflow error is also detected when an overflow occurs in the memory.
At this time the memory retains numeric value which has been stored in it until the overflow occurs.

7. CALCULATIONS

Observe the following instructions in order to obtain exact calculation results.

- Securely operate the keys one by one. If they are operated too quickly, numbers may not be properly entered or exact results may not be obtained.
- Before starting the calculation be sure to perform the following checking with the power switch turned on.
  power switch on → 0. (display)
  3513.6418 [×] [=] → 12345678.(display)

Addition & Subtraction

Ex. 1

Examples	Step	Operations	Display	Note
123 + 456 + (−789) − 345 =	1	123 [+]	123.	
	2	456 [+]	579.	
	3	789 [+/−] [−]	−210.	
	4	345 [=]	−555.	

Ex.2

Examples	Step	Operations	Display	Note
−1.23 − 5.67 + 6.78 =	1	1.23 [+/−]	−1.23	
	2	5.67 [+]	−6.9	
	3	6.78 [=]	−0.12	

Multiplication & Division

Ex. 1

Examples	Step	Operations	Display	Note
456 x 789 x 23 =	1	456 [×]	456.	
	2	789 [×]	359784.	
	3	23 [=]	8275032.	

Ex.2

Examples	Step	Operations	Display	Note
−5.6 x 7.8 x 2 =	1	5.6 [+/−] [×]	−5.6	
	2	7.8 [×]	−43.68	
	3	2 [=]	−87.36	

Ex.3

Examples	Step	Operations	Display	Note
456.789 ÷ (−12) ÷ 0.5 =	1	456.789 [÷]	456.789	
	2	12 [+/−] [÷]	−38.06575	
	3	.5 [=]	−76.1315	

Memory calculations

Ex.1

Examples	Step	Operation	Display	Memory register	Note
5 x 6 =	1	[C] [M+] 5 [×] 6 [=] [M+]	' 30.	30.	
+) 28 ÷ 4 =	2	28 [÷] 4 [=] [M+]	' 7.	37.	
Sum	3	[MR]	' 37.	37.	

Ex.2

Examples	Step	Operation	Display	Memory register	Note
5 x 8 ÷ 2 =	1	5 × 8 ÷ 2 = x-M	' 20.	20.	
—) 4 x 7 =	2	4 × 7 = M- M+	−28.	−8.	
Difference	3	RM	└ 8.	−8.	

Ex.3

Examples	Step	Operation	Display	Memory register	Note
(35 + 186) x (47 − 8) =	1	35 x-M	' 35.	35.	
	2	186 M+	' 186.	221.	
	3	47 − 8 × RM =	' 8619.	221.	

Ex. 4

Examples	Step	Operation	Display	Memory register	Note
(80 − 35) ÷ (13 − 7) =	1	13 x-M	' 13.	13.	Quotient of differences
	2	7 M- M+	└ 7.	6.	
	3	80 − 35 ÷ RM =	' 7.5	6.	

Constant Calculations

Ex. 1 5 [×] 3 [=] →15 Display
2 [=] →10 (5 x 2) Display
1 [=] → 5 (5 x 1) Display

Ex. 2 15 [÷] 3 [=] → 5 Display
30 [=] →10 (30 ÷ 3) Display
45 [=] →15 (45 ÷ 3) Display

Ex. 3 5 [+] 3 [=] →8 Display
2 [=] →5 (2 + 3) Display
1 [=] →4 (1 + 3) Display

Ex. 4 5 [−] 3 [=] → 2 Display
2 [=] →-1 (2 − 3) Display
1 [=] →-2 (1 − 3) Display

Power Calculation

Ex. 1 5 [×][=] → 25 (5^2) Display
[=] →125 (5^3) Display
[=] →625 (5^4) Display

Ex. 2 5 [×][=] → 25 (5^2) Display
[×][=] →625 (5^4) Display

Applications

Examples	Step	Operation	Display	Note
$\left\{\frac{(5 + 12) \times 18 \div 4 - 16}{4}\right\}^2 =$	1 2 3	5 [+] 12 [×] 18 [÷] 4 [−] 16 [÷] 4 [×] [=]	17. 76.5 228.76562	

Built-in Functions

As for the accuracy of function calculations refer to the item SPECIFICATIONS on page 29.

1. Trigonometric functions (sin, cos, tan)

Ex. 1 DEG •

Examples	Step	Operation	Display	Note
$\sin 30^\circ$	1 2	30 [F] [sin]	30. 0.5	

Ex. 2 • RAD

Examples	Step	Operation	Display	Note
$\cos\frac{\pi}{4}=$	1	[F] [π] [÷] 4 [=]	0.7853981	
	2	[F] [cos]	0.707107	

Ex. 3 DEG •

Examples	Step	Operation	Display	Note
tan 19° 29' 58" =	1	19 [°'"] 29 [°'"] 58 [°'"]	19.499444	° ' "
	2	[F] [tan]	0.354107	

2. Range of inverse trigonometric functions ($\sin^{-1}$, $\cos^{-1}$, $\tan^{-1}$)

$\theta = \sin^{-1}x \quad -90^\circ \leqq \theta \leqq 90^\circ \quad (-\frac{\pi}{2} \leqq \theta \leqq \frac{\pi}{2})$

$\theta = \cos^{-1}x \quad 0^\circ \leqq \theta \leqq 180^\circ \quad (0 \leqq \theta \leqq \pi)$

$\theta = \tan^{-1}x \quad -90^\circ \leqq \theta \leqq 90^\circ \quad (-\frac{\pi}{2} \leqq \theta \leqq \frac{\pi}{2})$

Ex.1 DEG •

Examples	Step	Operation	Display	Note
$\cos^{-1}$ 0.5 =	1 2	.5 [F] [cos]	0.5 59.99999	 about 60°

Ex.2 • RAD

Examples	Step	Operation	Display	Note
$\tan^{-1}$ 1 =	1 2	1 [F] [tan]	1. 0.785398	 about $\frac{\pi}{4}$

3. Exponential function (e^x)

Examplaes	Step	Operations	Display	Note
$e^{1.25}$ =	1 2	1.25 [F] [ln]	1.25 3.49034	

4. Logarithmic function

Ex.1

Examples	Step	Operations	Display	Note
ln 7 =	1 2	7 F [ln]	7. 1.94591	

Ex.2

Examples	Step	Operations	Display	Note
log 100 =	1 2	100 F [log]	100. 2.	

5. Power calculation (y^x)

Ex.1

Examples	Step	Operations	Display	Note
$5^{\frac{1}{3}}$ =	1 2	5 [y^x] 3 F [$\frac{1}{x}$] [=]	1.609438 1.709975	ln 5 (Ans.)

Ex. 2

Examples	Step	Operations	Display	Note
$(1.5)^{-3}=$	1	1.5 y^x	0.405465	Display of ln 1.5
	2	3 $+/-$ =	0.296297	

Ex. 3

Examples	Step	Operations	Display	Note
$10^{2.5}=$	1	10 y^x	2.302585	Display of ln 10
	2	2.5 =	316.2275	

6. Square calculation (X^2)

Examples	Step	Operations	Display	Note
$55^2=$	1	55	55.	
	2	F y^x	3025.	(Ans.)

7. Transformation of degree, minute, second into decimal notation degree (° ' '' →)

Ex.1 DEG •

Examples	Step	Operations	Display	Note
sin 45° 54' 5'' =	1	45 ⊞ 54 ⊞	45.9	
	2	5 ⊞	45.901388	
	3	F sin	0.718143	

Ex.2 DEG •

Examples	Step	Operations	Display	Note
cos 19° 36'' =	1	19 ⊞ 0 ⊞	19.	
	2	36 ⊞	19.01	
	3	F cos	0.945462	

8. Transformation of decimal notation degree to degree, minute, second. (→ ° ′ ″)

Ex. DEG •

Examples	Step	Operations	Display	Note
$\sin^{-1} 0.980689 = 78.72177$	1	.980689 [F] [4]	78.72177	78° (78 degrees) 43′ (43 minutes) About 18″ (18 seconds)
	2	[F] [5]	43.3062	
	3	[F] [6]	18.372	

9. Reciprocal calculation (1/X)

Examples	Step	Operations	Display	Note
$\dfrac{1}{\frac{1}{4} + \frac{1}{3}} =$	1	4 [F] [1/x] [+]	0.25	
	2	3 [F] [1/x] [=]	0.5833333	
	3	[F] [1/x]	1.7142858	

10. Square root calculation

Ex. 1

Examples	Step	Operations	Display	Note
$\sqrt{5}$ =	1	5	5.	
	2	F √	2.2360679	

Ex. 2

Examples	Step	Operations	Display	Note
$\sqrt{(10 + 11) \times 12}$ =	1	10 + 11 × 12 =	252.	
	2	F √	15.874507	

11. Applications

Ex.1 DEG •

Examples	Step	Operations	Display	Note
$\sin 30^\circ \times \cos_{,}18^\circ =$	1	30 [F] [sin] [×]	0.5	
	2	18 [F] [cos] [×]	0.951057	
	3	[RM] [=]	0.4755285	

Ex.2 DEG •

Examples	Step	Operations	Display	Note
$\tan^{-1}\left(\frac{1}{\sqrt{1+\left(\frac{1}{2.3}\right)^2}}\right)$	1	1 [+] 2.3 [F] [$\frac{a}{b}$]	0.4347826	
	2	[F] [$\frac{a}{b}$] [=]	1.1890359	
	3	[F] [$\sqrt{\ }$]	1.0904292	
	4	[F] [$\frac{a}{b}$]	0.91707	
	5	[F] [$\tan^{-1}$]	42.523	

Ex.3 DEG • Calculation of area

Examples	Step	Operations	Display	Note
Formula: $S = \frac{1}{2}ab\sin\theta$	1	60 [F] [Z] [×]	0.866025	$\sin\theta$
	2	6 [×] 3 [÷]	15.58845	$ab\sin\theta$
$a = 6, b = 3, \theta = 60°$	3	2 [=]	7.794225	$\frac{1}{2}ab\sin\theta$

Ex.4 Hyperbolic function (sin hx)

Examples	Step	Operations	Display	Note
Formula: $\sinh x = \frac{1}{2}(e^x - e^{-x})$	1	.5 [F] [$\frac{1}{x}$] [x^2]	1.64872	
	2	[F] [$\sqrt{\ }$] [$\frac{1}{x}$] [M+]	0.6065311	
$x = 0.5$	3	[MR] [÷] 2 [=]	0.5210944	$\frac{1}{2}(e^x - e^{-x})$

Ex.5 Transformation of amplification degree to decibel

Examples	Step	Operations	Display	Note
Formula: Transformation of amplification degree $= 10 \log \frac{P_1}{P_2}$[dB] $P_1 = 100W$, $P_2 = 200W$	1	200 ÷ 100 = F log	0.30103	$\log \frac{P_2}{P_1}$
	2	× 10 =	3.0103	$10 \log \frac{P_2}{P_1}$

Ex.6 Time calculation

Examples	Step	Operations	Display	Note
6 hrs. 24 min. 36 sec. + 5 hrs. 24 min. 30 sec.	1	6 °'" 24 °'" 36 °'"	6.41	
	2	+ 15 °'" 43 °'" 30 °'"	15.724999	
	3	=	22.134999	22 hrs.
	4	F °'"	8.09994	8 min.
	5	F °'"	5.9964	About 6sec.

* The followings out of built-in functions can be mixed with the other calculations: x^2, $\sqrt{\ }$, 1/x, π, °'" → , → °'"

Ex.7 Calculation including x^2, $\sqrt{\ }$, 1/x and π.

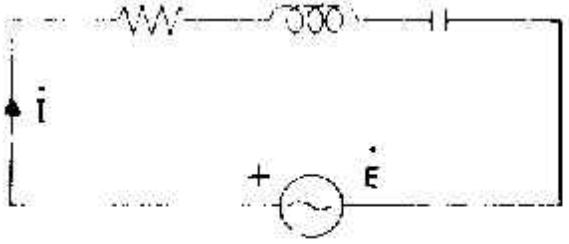
Examples	Step	Operations	Display	Note
$\frac{1}{\sqrt{4^2+3^2}}+\frac{1}{\pi}=$	1	4 F x^2 + 3 F x^2	9.	
	2	= F $\sqrt{\ }$ F 1/x	0.2	
	3	+ F π F 1/x =	0.5183098	

Ex. 8 Calculation of impedance of AC circuit

Calculate the impedance $|\dot{Z}|$ of series circuit shown left.
Here, R = 100Ω, L = 3H, C = 1 μF and f = 60 Hz.

$$|\dot{Z}| = \left|\frac{\dot{E}}{\dot{I}}\right| = \sqrt{R^2 + \left(2\pi fL - \frac{1}{2\pi fC}\right)^2}$$

R (Resistor), L (Coil), C (Capacitor)



Step	Operation	Display	Note
1	2 × F π × 60 ×	376.99111	$2\pi f$
2	3 = M+ .00000001 =	0.0003769	$2\pi fC$ (Contents of memory: $2\pi fL$)
3	F 1/x M+	2653.2236	$2\pi fL - \frac{1}{2\pi fC}$
4	100 F x^2 + MR	1522.2503	
5	F $\sqrt{\ }$ = F x^2	1525.5313	

8. CORRECTION OF MISTAKES

When false number is entered during calculation, depress the CE key. Then, only the false number is cleared.

Examples	Step	Operation	Display	Note
123 + 455 → 123 + 456 (false) (correct)	1	123 +	123.	False number
	2	455 CE	0.	455 is cleared
	3	456 =	579.	(Ans.) 123 + 456

If the arithmetic calculation keys (× ÷ + −) are operated by mistake, depress the correct key successively. Then, correct instruction replaces the preceding instruction.

Examples	Step	Operation	Display	Note
	1	7 ×	7.	False instruction
7 x 8 → 7 ÷ 8	2	÷	7.	Correction of the instruction
(false) (correct)	3	8 =	0.875	(Ans.) 7 ÷ 8

9. SPECIFICATIONS

Model: EL-8109
Capacity: 8 digits (Decimal part $\leqq$ 7 digits)
Calculation range:

- Input & four arithmetic calculations result $\leqq$ 8 digits (Decimal part $\leqq$ 7 digits)
- **Built-in functions**

	Accuracy of result	**1st operand**
Trigonometric function: sin, cos, tan	6 digits (max. error, ±1 at 6th digit)	DEG● $\lvert x \rvert \leqq 360^\circ$ ●RAD $\lvert x \rvert \leqq 2\pi$
Inverse trigonometric function:	6 digits (max. error, ±1 at 6th digit)	
$\sin^{-1}$, $\cos^{-1}$		$\lvert x \rvert \leqq 1$
$\tan^{-1}$		$\lvert x \rvert \leqq 3437.4667$
Exponential function: e^x	6 digits (max. error, ±1 at 6th digit)	$\lvert x \rvert \leqq 18.420681$
Logarithmic function: ln, log.	6 digits (max. error, ±1 at 6th digit)	$0 < x \leqq 99999999$

Power function: y^x	5 digits (max. error, ±1 at 5th digit)	$\begin{cases} 0 < y \leqq 99999999 \\ x \leqq 99999999 \end{cases}$
Others: x^2	8 digits	$\lvert x \rvert \leqq 9999.9999$
$1/x$		$0 < \lvert x \rvert \leqq 99999999$
$\circ\ ' \ '' \rightarrow ,\ \rightarrow \circ\ ' \ ''$		$0 \leqq \lvert x \rvert \leqq 99999999$
Square root calculation:	7 digits (max. error, ±1 at 7th digit)	$0 \leqq x \leqq 99999999$

As for tan$x$, however, the accuracy of calculation is lowered in the following ranges:

DEG• x: $90 \cdot n \pm 3$ Here, n = −3, −1, 1, 3

•RAD x: $\frac{\pi}{2} \cdot n \pm 0.04$ Here, n = −3, −1, 1, 3

Decimal point:	Complete floating decimal point positioning
Sign:	True figures with a minus sign
Registers:	Calculation register: 8 digits, 3 words Memory register: 8 digits, 1 word
Calculations:	4 arithmetic calculations, chain multiplication and division, constant calculation, power calculation, sum (difference) of products (quotients) and individual product (quotient), product of sums (differences), quotient of differences, trigonometric function, inverse trigonometric function, exponential function, logarithmic function, power function, square calculation, degree, minute, second ↔ decimal notation degree transformation, reciprocal calculation, square root calculation and practical calculations.
Components:	LSI, etc.
Display:	Power-saving type fluorescent display tube (optionally available AC adaptor EA-14A)

Using time of battery at 20°C:	Manganese long-life battery ..... about 5 hrs. Ni-Cd battery .....about 6.5 hrs. (charging time 15 hrs.) (The service life slightly changes according to the kinds of the batteries and the way of use.)
Temperature:	0°C ~ 40°C
Power consumption:	0.45 W
Dimensions:	27(H) x 83(W) x 139(D) mm
Weight:	230g (with batteries)